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E S S A Y, &c.



Ryder (James) Surgeon

AN
E S S A Y
UPON THE
NATURE, CAUSES, PREVEN-
TION AND CURE
OF THE
SCURVY OF MARINERS:
WITH
Defultory Observations, Chemical Reflec-
tions, &c.

BY
JAMES RYMER,
Surgeon of His Majesty's Royal Navy.

LONDON:
PRINTED FOR THE AUTHOR; AND SOLD BY
THOMAS EVANS, BOOKSELLER, NO. 46,
PATER-NOSTER ROW.

1793.



T O
HIS ROYAL HIGHNESS
WILLIAM HENRY,
DUKE OF CLARENCE AND ST.
ANDREWS,
EARL OF MUNSTER IN IRELAND,
A REAR-ADMIRAL OF THE BLUE,
K. G. AND K. T.

S I R,

THE health of seamen on
board his Majesty's fleet
being a circumstance upon
which are founded the secu-
rity, prosperity, and dignity of
Great Britain and Ireland, &c.
and having acquired in many
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years service on board his Majesty's ships, in various climates, as Surgeon, some experience in the diseases to which, from their manner of life, diet, &c. seamen are most liable in long voyages, I humbly presume to address to your Royal Highness a few hints, which, I trust, under the approbation and sanction of your Royal Highness, may not fail to produce useful effects.

Of the importance to these united kingdoms, of measures, however costly, to preserve the health of mariners, your Royal Highness is perfectly sensible ;
and

and I am fully persuaded, that no man can or will be more strenuous and zealous than your Royal Highness, in adopting such attainable means as may appear to be the most effectual to accomplish an end so desirable as the prevention of the scurvy on board his Majesty's ships.

I flatter myself it will appear in the following pages, that the principal causes of scurvy in long voyages proceed from the nature of the food and drink of seamen; that the means of preventing and curing this deplorable and destructive ma-

lady bid defiance to all the powers of medicine ; and that the principles of prevention and cure are certainly and solely to be obtained from the use of fresh meat, and fresh vegetables and fruit, and such other articles of food and drink as contain the animal and vegetable principles in greatest quantity and perfection.

Of fresh meat, vegetables, and fruit, we cannot always avail ourselves at sea ; but, thank God ! we can command and enjoy powerful substitutes.

The chief substitutes are
bread

bread and wine, including cider, porter, ale, &c.

Bread, so emphatically termed the staff of life ; that grand source of human sustenance, from whose principles all animal matter is derived, should be made of the finest and most wholesome flour : it should be of the very best of what is called *Captain's Biscuit*; and not that common coarse stuff, composed in great part of bran, which yields little nourishment, soon becomes the nest and prey of various insects, speedily unfit for the use of man, and, in this rapid state of decay,

decay, often in great quantities condemned by survey, and thrown overboard. Such superfine biscuit should be preserved in water-proof casks.

The *Wines* should consist of the best Red Port, Madeira, and the superior Portugal and Spanish white wines.

Cider should be of the first and strongest quality.

Of the good effects of cider in scurvy I shall mention a notable instance. During the unhappy war with our brethren in America, in one of our cruises

cruises we took a vessel having newly-made cider on board. A quantity of it was put under my care for the use of the sick. I gave it only to persons having the scurvy in a high degree, and it had considerable effects in recovering them. This cider, however, in our cider counties, would have been esteemed mere ciderkin.

The *Porter* and *Ale* ought to be such as conscientious brewers, at the risk of fame, freely recommend.

Vinegar should never be admitted

mitted on board his Majesty's ships, until approved of by skilful and upright judges.

I humbly beg leave to state it as my firm opinion, that the above articles should be supplied in the most liberal manner; and that contractors, and others, who did not furnish them of pure and genuine qualities, ought to be punished in the most exemplary way.

Particular attention should likewise be paid to the qualities of beef, pork, fuet, butter, cheese, oil, raisins, currants,
&c.

&c. Beef and pork should never be salted in states approaching to putrefaction, and then put up in casks in a filthy manner.

I have often suspected the essence of malt, as it is called, and prepared for the navy, to be a gross imposition; consisting, for the most part, of a mere infusion of malt, mixed with treacle or coarse sugar, &c. inspissated to the approved consistence.

The following roots deserve notice, as being efficacious in
scurvy,

scurvy, and easily preserved, viz. potatoes, carrots, and parsnips. These roots are allowed to contain farina, starchy or coagulable matter, sugar, mucilage, &c. Whether, in their organised state, these principles exist or not, is immaterial: it is sufficient to declare, from experience, that, when daily submitted to the action of the stomach of a person labouring under scurvy, good and salutary effects are, in due time, perceived. They should be eaten in their raw or crude state.

Water.

Water.—It is presumed that water for common drink may be preserved in long voyages by one or two gallons of brandy, or spirit of wine, added to each cask.

That the navy of Great Britain may greatly flourish under the auspices of your Royal Highness; and, that Providence may bless your Royal Highness with long life, health, and happiness, to diffuse those amiable examples of public virtue and private worth which shine so brightly in all the actions of your illustrious parents,
whom

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whom God preserve! is the
heartly wish of,

S I R,

Your Royal Highness's
Most Respectful,
And most Obedient
Humble Servant,

JAMES RYMER.

Gerrard-street, Soho,
Dec. 23, 1792.



CHE-

C H E M I C A L
REFLECTIONS, &c.

DR. LIND thinks, with many other learned and ingenious men, that the marine or true Scurvy "seems to be induced by the agency of certain external causes." In this light the Scurvy was viewed as an epidemical disease.

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The Scurvy had been observed to rage among German foldiers in Hungary, among troops closely befieged, and throughout whole countries, as Brabant, in 1556, and Holland in 1562.

In an especial manner the Scurvy had been observed to prevail on board ships, among seamen in the course of long voyages.

The scurvy was supposed to be endemic, or constant, in Iceland, Greenland, Cronstadt, and in northern countries from the latitude of 60 to the pole: also peculiarly endemic in the
low

low countries in Friesland; in Brabant, Pomerania, and the lower Saxony; in parts of Denmark, Sweden, and Norway, especially upon the sea coasts, where they always consume a great quantity of ardent spirits.

The Scurvy raged fatally amongst the troops under the command of General Murray, at Minorca. This is the latest instance of the Scurvy prevailing amongst besieged troops.

Sea salt, and drinking seawater, have been found not to be the cause of scurvy, by Dr. Lind. Sea salt, as an article of diet, used in the way people use

it in general, certainly cannot produce scurvy. Sea water, taken occasionally as a purge, will not produce scurvy. We have an instance of sea salt being a powerful antiseptic, inasmuch as it preserves animal substances from putrefaction; witness salt beef, salt pork, salt fish, &c.

It is recorded that the scurvy broke out on board Lord Anson's squadron, when there was plenty of fresh meat on board. We very well know that fresh meat, instead of producing scurvy, will have a share in the cure of it; wherefore in the above case, there must have been

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a powerful cause of scurvy prevailing, which fresh meat could not counteract. What that cause was we shall consider and endeavour to prove, very clearly, by and by.

The saline effluvia from the sea, Dr. Lind thinks, have no share in producing scurvy. He quotes, in support of this, the good health enjoyed by the men who work in the salt pits in Poland, who must be exposed to the vapour of the marine acid; few workmen are said to be more healthy.

The saline effluvia, or the vapour of the marine acid at

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sea,

sea, as it has a great affinity with phlogiston, I think, cannot produce scurvy. The vapour of the marine acid is a powerful antiseptic.

Dr. Lind thinks, and brings plausible arguments to support it, that abstinence from vegetables and fruit can be but the *occasional* cause of scurvy ; such as tedious blockades by the ancients, till they forced a surrender by famine ; yet the ancients have given us no account of the scurvy in consequence of it. The Doctor says, “ it would be tedious to give many instances, they being wellknown of ships crews continuing several

ral months at sea upon their ordinary diet, without any approach of the scurvy. I have been three months on a cruise, during which time none of the seamen tasted vegetables or greens of any sort; and although, for a great part of that time from want of fresh water, their beef and pork were boiled in the sea water, yet we returned into port without one scorbutic complaint."

Abstinence from vegetables and fruit will not produce scurvy, if seamen and others, in such a case, be supplied with such things as yield the same principles, viz. vegetable fixed air and

vegetable phlogiston, or phlogiston modified by vegetation. The ancients, in their tedious blockades, if deprived of vegetables and fruit, must have had something to eat or to drink which abounded with, and easily yielded in the stomach, vegetable fixed air, otherwise we should have heard of their having suffered by scurvy. If seamen have continued free from scurvy several months, as I have known it to be the case, at sea, upon ordinary diet, it may be depended upon they were furnished with something which answered the end of vegetables and fruit.

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In subsequent cruises, Dr. Lind had experience of the scurvy raging in his Majesty's ship Salisbury, in less than six weeks after having left Plymouth, where plenty of all sorts of greens was to be had; "by which (the Doctor says) as one would have thought, the sailors had sufficiently prepared their bodies against the attack of this malady." In this channel squadron, out of 4000 men, 400 were violently afflicted with the scurvy. The Doctor adds, "and what puts it beyond all doubt that the disease was not occasioned solely by the want of vegetables for so short a time, is, that the same ship's company
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of the Salisbury, in much longer cruises, kept quite free from the distemper, where their circumstances, as to the want of fresh vegetables, were similar."

The human body can never, by the use of vegetables and fruit, be sufficiently prepared on shore to resist all attacks of scurvy at sea, if then cut off from every supply of vegetable principles: under such circumstances, every seaman will be most liable to scurvy. Farmers, countrymen, landsmen, at sea, suffer soonest, and more than seamen, when suddenly deprived of diet and drink, which yield
the

the constituent principles of vegetables.

If seamen labour under the cause of scurvy in certain states of the atmosphere and degrees of heat they have not been accustomed to, the disease will be more or less malignant. This is a fact with respect to every disease.

Above one half of the people on board Lord Anson's squadron died of scurvy when they had been but little more than three months at sea, while whole countries are observed to live on the same, nay even a less wholesome diet; and many people

people for years abstain from vegetables, without almost any inconvenience. Thence Dr. Lind concludes " there are unquestionably to be found at sea other strong sources of scurvy," which he terms *pre-disposing* causes.

Because above one half of Lord Anson's people died of scurvy, when they had been but little more than three months at sea; because whole countries may have been observed to live upon the same, or even a less wholesome kind of diet; and because many people abstain from vegetables for years without almost any inconvenience,

convenience, we are not thence to conclude that there are strong sources of scurvy at sea, or peculiar to the sea life. So far as I can judge it is really not so. Thousands and thousands have lived on shipboard forty, fifty years, and upwards, without ever having had the scurvy; but then, depend upon it, they were not deprived of fresh supplies of vegetable principles; without which, human life, on board, or on shore, cannot long subsist.

The confined and polluted air in a ship, and the stagnation of the *bilge-water* in the hold, do not render the persons most exposed to them more liable to
scurvy

scurvy than others on board. Dr. Lind believes this from his own experience, and from the accounts of others.

If the common air rest upon a surface of putrid water, it is always diminished, and rendered noxious to respiration and flame. This effect will happen sooner if such water, viz. water highly charged with a combination of phlogiston and alkaline air, be agitated. Bilgewater, which smells very offensively, is for the most part agitated in ships at sea; and frequently the air in a ship's well has instantly killed men who breathed it. Confined and polluted

luted air in a ship, or air super-phlogisticated, and rendered otherwise noxious by animal steams, although it be in the highest degree deleterious, yet it will not produce scurvy. The scurvy arises from a very different cause.

Filth, or want of cleanliness, in a close place, and where the perspiration of a multitude of people is pent up and confined, Dr. Lind thinks, rather produces that evil disposition of air from which arises the contagious fever called the *jail distemper*. This is rational and probable.

Dr.

Dr. Lind says, the scurvy by itself is often experienced to make great ravage where the air has been properly renewed and ventilated, and the whole ship kept clean and sweet; "and what is farther pretty remarkable, we know (says he) that the scurvy may be perfectly cured in the impure air of a ship."

In a voyage to North America, on board his Majesty's ship America, during the finest weather, and in the cleanest and sweetest of ships, the scurvy made great havock. Samuel Thompson, Esq. the commander, whose attention to cleanliness, and humanity to the sick, could

could only be exceeded by his skill as a seaman, and his bravery as an officer, spared no pains nor expence to prevent and remove the melancholy evil; but as the cause of the disease was the want of vegetable principles, whatever was done at sea did not avail. If seamen, breathing the purest common air, be deprived of the constituent principles of vegetables for a certain time, the scurvy will assuredly shew itself amongst them: if, on the contrary, seamen, having the scurvy, and breathing the common air rendered noxious in some degree in a ship, be properly supplied with whatever yields the vegetable principles,

ciples, the scurvy will certainly be removed.

Dr. Lind says, " It must be allowed, that the air, which is a compound of almost all the different bodies we know, has many latent properties by which animals are variously affected; and these we neither can at present, nor perhaps ever shall, be able to investigate. We do not (says he) even know certainly what this *pabulum vitæ* is, in that fluid, which preserves and supports human life."

The great Dr. Priestley has analysed the common air in a very plausible, and, I think, probable

bable manner. Whichever way I consider Dr. Priestley's account of the constituent parts or principles of common air, it seems to be chemically and philosophically consistent, and agreeable to the laws of material combination. If I understand the Doctor, he looks upon common air to be a neutral fluid, composed of an acid air and modified phlogiston. The acid air may be either fixed air, nitrous air, marine acid air; or, it may be an acid air, consisting of a combination of fixed air, nitrous air, and marine acid air. An acid air (if so, or otherwise compounded) is rationally supposed to have an affinity with

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phlo-

phlogiston, under a certain modification ; so that phlogiston thus modified, may be considered, in this combination, as an alkaline air. Common air, thus formed, is a *menstruum* or solvent, and vehicle and receptacle for exhalations ; some of which, with common air, would seem to form a mixture and not a solution. Smoke, in general, rises in air, rendering it cloudy, till it be condensed, when it falls in various ways upon the earth. Watery vapour sometimes only mixes in the air, and at other times is perfectly dissolved in it ; but, in the clearest, and most apparently dry, state of the air, any dry fixed alkaline salt exposed

posed to it will attract the watery vapour, and become wet. When the atmosphere, from a very clear state, becomes suddenly cloudy, and lets fall its watery contents in rain, we may suppose some decomposition to have taken place; the watery vapour either having lost something, or acquiring some new principle, the attraction of cohesion takes place among the particles, which increasing in weight, more matter in less space, gravitation is the result: or, the common air supporting the watery vapour, robs it of its phlogiston, and causes the precipitation. Lime-water, perfectly clear and transparent as

distilled water, is no sooner exposed to fixed air, than it becomes turbid, owing to the particles of lime in the water acquiring the calcareous state from their union with fixed air, which is one of the essential constituent principles of calcareous matter. Changes, from analogous causes, may, and there is no doubt but it is so, happen in the atmosphere. Perhaps watery exhalations carry up some principle which the atmosphere requires, and bring down something, not only for its own purity as water, but for the nourishment of vegetables and animals. What water seems purer, clearer, more transparent than

than some pump-water, well-water, or hard water? The moment you drop into it a few drops of a solution of any fixed alkaline salt, as oil of tartar, it becomes turbid and milky. Hard water contains in solution what the chymists term a *selenetic salt*: a selenetic salt is the vitriolic acid and calcareous earth combined; when oil of tartar is dropped into it the selenetic salt is decomposed; the vitriolic acid having a greater affinity with fixed alkaline salt than it has with calcareous earth, quits the latter and unites with the former. The calcareous earth now subsides in the form of a white matter.

When we say, *impure* air, we mean that the common air is charged with matter foreign to it; various vapours and exhalations which the atmosphere in certain states is capable to suspend and keep diffused for a time. Thus we say *impure* water, whenever its colour and taste are changed from their natural or common state. Impure water is purified by distillation, and impure air is rendered pure by some natural process in the course of God's providence. Water exhales with phlogiston from its impurities, and is received by the atmosphere, which suspends it till it must fall in dew, rain, snow, or hail.

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The common air, with respect to the respiration of animals, contains no *pabulum vitæ*: common air, in this view, is merely a vehicle for superabundant phlogiston, putrid effluvia, and watery vapour from the lungs of the animal. As in every animal there is a constant change going on, a continual succession of matter; matter thrown out as effete and an accession of new matter, the lungs may be viewed in one light as a grand pneumatic engine for throwing out of the system a quantity of excrementitious matter in the form of vapour, which the common air receives, and disposes of agree-

agreeably to the laws of nature or God's providence. Air may be either noxious to animal respiration, on account of the quality of what is mixed with it, or because what is mixed and dissolved in it renders the air incapable to receive that matter which the lungs naturally throw out of the system in the form of vapour.

The common air, considered as a neutral fluid, may be decomposed by whatever have a greater affinity with one of its constituent principles than that have with the others. I have no doubt but this happens frequently, when the air newly
com-

compounded, may have qualities which render it unfit for respiration. Phlogiston would appear to be the universally active principle throughout all nature: guided by the will of the Majesty of the Universe, phlogiston seems to be the cause of animal life, of vegetation, of the various attractions, and of all the phenomena and operations of Providence, which we do not as yet comprehend; with an aërial base it forms air, with a vegetable base it forms whatever appertains to the vegetable kingdom, with a mineral base it forms all minerals and fossils, and, with an animal base, it constitutes all living creatures,

tures and continues them in being so long as God's providence thinks fit ; when, some natural cause, some mechanical action, renders the human body no longer a proper mansion for the immortal soul.

Animal oils and fat, we all know, are highly inflammable. It would appear, while animal oils and fat are in the state of decomposition, by ignition, or burning, that they consist chiefly, of phlogiston. Animals cannot exist without phlogiston ; nature seems to have laid up a store of it in the adipose membrane to be taken into the circulation,

circulation, in cases of inanition and disease.

All vegetable substances abound with phlogiston. Phlogiston, fixed air, and a portion of earth seem in general, the watery part having been evaporated, to be the essential constituent principles of vegetable matter. The earthy part of most vegetables seems to be changed by fire into a fixed alkaline salt.

In autumn it would appear, that most trees and plants, especially in northern climates, are fully saturated with phlogiston, and can receive no more for that year.

year. How highly inflammable are all the leaves which fall in autumn from the trees! and these leaves were all formed in the course of only a few months. What a prodigious quantity of phlogiston must the vegetable kingdom imbibe, during the course of one year only! It is wonderful, when we consider under what a variety of forms and modes phlogiston exists. Rectified spirit, alcohol, appears to consist of phlogiston only. We are certain that this spirit is of vegetable origin; the vinous fermentation could not create it: it existed, though in another form or mode, in the juice of the grape, in sugar, malt,

malt, &c. previous to these matters having undergone the spirituous fermentation.

Many minerals consist of nothing besides phlogiston and earth. Some fossils are, in the highest degree, inflammable. Inflammable substances, in general, will not burn unless they be acted upon by some agent. Fire, ignition, exists when any inflammable matter is in the state of actual fiery decomposition: to produce this effect an actual fiery yeast, or ferment, is necessary; and this fiery yeast, or ferment, appears to me to be nothing more than phlogiston in its actual fiery state,
issuing

issuing from one inflammable substance, in the act of burning decomposition into any other inflammable matter, whose latent or fixed phlogiston becomes thereby active, quitting its earthy base, and is now greedily received by the common air. The common air is never fully and universally saturated with phlogiston; if it were, nothing would burn in it, no animal could breathe it. The atmosphere is continually losing and receiving phlogiston. There is an universal circulation of phlogiston throughout all nature. While a lamp, a tallow candle, or a wax candle, is burning, we may observe the dissipation of
oil,

oil or spirit, of tallow, of wax; neither of which, if pure, leaves any considerable residuum; consisting chiefly of phlogiston and vapour, which the common air receives.

A given quantity of common air will receive but a certain quantity of phlogiston. A candle will burn but one minute in one gallon of common air, which then will be fully saturated with phlogiston. An animal cannot breathe this air, because such air is unfit to receive what the animal discharges from its lungs in expiration.

When the lungs of a living creature are fully inflated by
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an inspiration of common air, they may be said to be inflated with phlogistic and putrid air, which we very well know to be the quality of expired air. Perhaps an animal dies the instant its lungs are overcharged with such vapour, when it can have no timely vent.

The common air seems to suffer decomposition by animal respiration: it would appear to quit some one of its constituent principles, forming an union with something from the lungs. Fixed air is precipitated in expiration; for, breathing upon lime-water renders it turbid.

bid. Perhaps the fixed air comes from the animal's lungs : air has been collected from large scorbutic ulcers, which has had the same effect upon lime-water.

Putrid effluvia, I am inclined to think, consist of phlogiston combined with an alkaline air, both of the animal and vegetable kind, i. e. whether it arise from vegetable or animal decomposition. Both kinds are intolerably offensive, although the sense of smelling discover a difference. Such air, together with fixed air, is plentifully discharged from carious bones, and putrid sores of all kinds. The parts so affected may be said to

be in a state of dissolution. In putrid fevers such air is discharged copiously, not only from the lungs, but from the surface of the body; and also by urine and stool. Such air, received into the system of a healthy person, is capable to produce the same phenomena; it being a ferment.

In the advanced state of the sea scurvy there is not only a separation of phlogiston and alkaline air from the solids, but also a very great quantity of fixed air. A person so affected is really in a state of actual dissolution and decomposition; the attraction of cohesion is destroyed,

destroyed, or ceases to act; and the constituent parts of the animal fibre repel each other and escape.

Fixed air enters in great abundance into the animal system: it is certainly one essential component principle of the animal constitution. Fixed air escapes very copiously in the scurvy.

An animal body is made up of fibres or threads; and every fibre or thread is composed of less fibres *ad infinitum*. No person has ever discovered the original fibre; and it is probable no one may ever discover

and comprehend its nature. Although we be very ignorant of the constitution of elements, yet we are very certain that fibres, or fleshy threads, constitute the various animal organs. When the principle of cohesion ceases to act in an animal fibre, its constituent parts, as I observed before, repel each other. Now, though we know not the nature of these constituent parts, when in a state of union, we are very certain that phlogiston, alkaline air, and fixed air, in abundance, arise from every part of an animal in a state of actual decomposition. Muscle, or red flesh, is made up of tubes or vessels,
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and these tubes, or vessels, are composed of fibres; when these fibres decompose, the vessels of course cannot hold their contents, extravasation takes place, and, as in the scurvy, are diffused and accumulated in and about the affected parts, forming and causing in the scurvy the various swellings, discolourations, bumps, stiffnesses, rotten gums, and the whole phenomena of the disease. The heart, and all the large vessels about it, losing their tone and elasticity, the cavities become wide and enlarged in diameter; and when the body, in the advanced state of the disease, is placed in the erect posture especially, the
blood

blood suddenly gravitates from the brain. Hence one principal cause of fainting and sudden death, when scorbutic patients are taken out of bed to be sent to hospitals from ships, or are so disturbed for any casual reason.

Some diseases appear to me to be nothing more nor less than a tendency to animal decomposition. This tendency to animal decomposition in a living creature is sometimes local, and at other times it is universal throughout the fleshy and fluid parts, as in fever.

Decomposition may take place in a gland, in part of a bone,

bone, of a muscle, of adipose membrane. Part of the liver, the lungs, the brain, or of any organ, may be in a state of decomposition. The injury done to health by such local decomposition will depend upon the office of the organ so affected.

In a tendency to universal decomposition, in a living man, the constituent animal principle which is disposed to separate from the rest and escape, may be either phlogiston, fixed air, or alkaline air, or a peculiar acid air. In the scurvy it would appear to be chiefly fixed air which is disposed, in a high degree, to quit the system. But,
 whatever

whatever cause dispose one constituent principle to quit its animal nature, the others would appear in a greater or less degree, to be disposed to separate also.

It would appear, there can be no vapour, no exhalation from animal bodies, without phlogiston. It would also appear that a certain quantity of modified phlogiston gives natural colour to the blood, and keeps it in a due consistence; any increase or diminution of which will be attended by morbid symptoms.

In an animal body there be a phlogiston peculiar to the brain and nerves, independent
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of that phlogiston which enter into the constitution of brain and nerve. The spinal marrow and the nerves appear to me to be the excretory system of the brain and cerebellum. The great quantity of blood sent to the brain and cerebellum, I think, furnishes that ethereal phlogiston, which, directed and guided by the immortal soul, is the cause of all animal and vital phenomena.

There be a phlogiston peculiar to the gross circulating fluids and animal solids, modified according to the nature of the matter: boney matter, fleshy matter, fatty matter, containing
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the same principle, under different modes of combination.

In *inflammatory* diseases there would seem to be a superabundance of a kind of active phlogiston in the system. Nature appears to labour till the quantity be diminished by respiration and the watery evacuations; watery fluids imbibing phlogiston very powerfully.

In *putrid* diseases, again, there would appear to be a deficiency of active or vital phlogiston, and a waste of fixed or material phlogiston. In *putrid* diseases this constituent phlogiston, become now excrementitious, escapes abundantly from the lungs. In *putrid* diseases phlogiston

giston and alkaline air seem to be set loose throughout the system, and, combining, are thrown out of the body in the mode of putrid effluvium; in which state, as from the plague or gaol distemper, I look upon it to be a fatal ferment if received into a healthy constitution in sufficient quantity: common air impregnated by such vapour, is, in the highest degree, dangerous to mankind.

Besides the phlogiston which enters into the composition of animal matter, as I have already observed, and wish to repeat, a living creature would appear to require a certain quantity of it under a peculiar modification,
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and nice equilibrio, for carrying on the vital and active offices. The former I would be inclined to call fixed phlogiston ; and the latter, volatile, vital, ethereal, phlogiston ; confined to the brain and nervous system.

To preserve and continue health, an animal body must be supplied with aliments which contain all the constituent principles of animal and vital matter ; of which principles, any one being wanting, either on account of its not existing in particular aliment, or because some aliment, containing it, does not yield it in the course of digestion, disease will be the result. On shore, or at sea, if vegetable

getable fixed air be not taken in with the aliment, and detached in the stomach and intestinal canal, the true scurvy will soon shew itself.

When *disease* terminates fatally, notwithstanding the morbid state of organs, the brain excepted, death may be the consequence of the blood containing no materials, or *pabulum*, for the preparation of vital phlogiston in the brain and cerebellum.

An animal body is constantly in a state of change. There is a demand for fresh materials, for fresh matter, capable to furnish the principles of the animal constitution, which are continually

ally in a state of, now, attraction ; and, now, of repulsion.

In diseases in which the bark is used with success, I conceive the bark to be efficacious by some way or another increasing the power of attraction of cohesion, thereby enabling the animal fibre to retain its constituent principles a due time.

The bark will not be efficacious in the scurvy, if there be a want of that aliment which is capable to furnish one or other of the constituent principles of the body ; and which, in this disease, would appear to be, certainly, vegetable fixed air.

One

One reason, perhaps, why an animal body requires a constant supply of fresh principles, is, that it may be able to counteract the pressure of the atmosphere, in a degree consistent with the well-being of the creature. Air, which forms a great part of the animal body, if it be retained longer than it ought to be, that is, if it have not been renewed; the old air thrown out of the system, and new air received in lieu, such old air would appear to become rarefied and expanded, bursting its boundaries, and, retained by membraneous parts, causing swelling and tumour. We see dead bodies in the open air swell prodigiously, notwithstanding

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standing the pressure of the atmosphere. The fixed air, taken up in a condensed state, seems to be now liberating itself, acquiring elasticity and expansion : or, the constituent parts of such air may be now in a state of repulsion, which may go on till the particles shall be just within the sphere of each other's attraction, like clusters of air bubbles. What a distressing case would it not be if our constituent air were to expand thus while in life ! Indeed, when the mercury falls in the tube of the barometer, towards 28 inches, many people feel as if something of that kind were about to happen : there is no doubt but
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it would in an exhausted receiver.

That our fixed air, in the scurvy, becomes, in some degree, elastic and expansive, dilating and detaching itself in the universal tendency to decomposition, I think is probable, in whichever way I consider the subject.

That phlogiston exists in a detached state in the intestinal canal, upon peculiar occasions, is certain. Inflammable air is frequently discharged from the anus. The flame of a candle, held at a proper distance, will cause an inflammable *flatus*

to explode. This particular kind of *crepitus ventris* has an intolerable and peculiarly offensive odour. It would appear to consist of phlogiston and alkaline, or putrid air.

The human fœces are strongly impregnated with the phlogistic principle. Air that has rested a sufficient time upon human fœces in the funnel of an old privy, is frequently highly inflammable. Indeed such air may have arisen wholly from the fœces. Much phlogiston is discharged from the system, with the excrement, by stool. Fluid matter imbibes phlogiston; whence the great thirst attending

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ing inflammatory diseases. Nature adopts this method to get rid of superabundant detached phlogiston. The drink taken into the stomach imbibes the phlogiston, and by the natural outlets it passes off; whence, also, the increased action of the heart and arteries, the rapid circulation of the blood, and the consequent phenomena of inflammatory fevers.

In cases of indigestion, when the stomach has been overcharged with flatulent and indigestible aliment, thirst may arise from another cause, or, rather, for a similar reason, viz. to absorb, or imbibe fixed and other

air, in the stomach and intestines. Cold *boiled* water is best in such cases, it being previously deprived of great part of its own air, is disposed to imbibe a greater quantity of other air.

Dr. Priestley thinks that the instantaneous death of animals put into vitiated air is owing to some *stimulus*, which, causing universal and violent convulsions, exhausts the whole of the *vis vitæ* at once. His reason for thinking so is, because the manner of their death is the very same in all the different kinds of noxious air. But, humbly begging leave to differ a little in opinion from an author
so

so great and justly celebrated, I think the phenomena of the epilepsy would seem to contradict the whole of the *vis vitæ* being exhausted at once by universal and violent convulsions. The stimulus, in the former case, would rather appear to me to arise from that nice equilibrium of vital phlogiston being instantaneously destroyed in the system. There would seem to be an immediate retrogradation, regression and accumulation of the vital phlogiston in the brain and nerves, in consequence of the quantity of phlogiston usually thrown out of the lungs being suddenly detained in them; nature struggling to dispose of

it to free herself from actual super-phlogistication, throws the whole muscular system into action.

As it happens to a jar overcharged with the electric matter or principle (which, by the bye, would appear to be phlogiston under a peculiar modification) so the vital phlogiston in the brain, cerebellum, and medulla spinalis, discharging and exploding, may cause some derangement in the texture and substance of these organs; whence, death.

With respect to the matter discharged from the lungs of animals

animals in expiration, I look upon it to be an excrementitious phlogiston combined with alkaline and fixed air. I remember, being on board one of his Majesty's ship's, in the Mediterranean sea, nearly half way between Carthagen and the coast of Barbary, a whale emerged close along side of the ship, to windward, to discharge its air, and take in a fresh supply. The smell of the air which it discharged, was more offensive and insufferable, than any kind of putrid effluvia I ever met with. Several persons on board, as well as myself, were affected with momentary suffocation; and we became sick at the stomach, with an inclination to reach. A kind
of

of faintness and languor remained with us some time.

That certain air or vapour, arising from vegetable and animal matter, in *certain* states of decomposition, is capable of acting as a ferment, if received completely and in sufficient quantity, into the human system, I firmly believe.

It appears rational to me, whenever any such vapour, ferment, or miasma, have been received into the animal body, producing therein a tendency to fermentative decomposition, that whatever completely check such tendency to fermentation
and

and decomposition, is, of course, the substance which will cure the disease.

In intermittent fever, whatever be the cause of this disease, whether marsh-effluvia, or not, there appears to me to be an alternate ebbing and flowing, a successive diminution and increase of vital and fixed phlogiston. The phenomena of the cold fit exhibit evident signs of universal debility and diminished energy of the vital and moving powers. The phenomena of the hot fit as evidently shew a general increase of vital power, and accumulation of phlogiston. The sweating state
exhibits

exhibits the method nature adopts to bring about an equilibrium.

Whether, in certain states of the body, there be any affinity or attraction between the vital and fixed phlogiston of animals, and whether the former be ever converted into the latter, and *vice versa*, is beyond my comprehension to decide. But, in the progress of intermittent fever, as the animal matter is universally diminished, the whole body emaciated, it is evident decomposition must have been going on from the first attack. Perhaps, in this disease, phlogiston is the constituent

ent principle most disposed to become volatile, and to quit the body. However it be, no substance has been hitherto found so capable to check this disposition, as the Jesuit's bark.

In *lues venerea* there is decomposition wherever that peculiar ferment which occasions the disease is retained; as in gland, bone, and parts in contact with the venereal ulcer, or caries. Whichever way mercury act, whether chemically with the virus, or mechanically upon animal fibre, it is certain, that when the affected parts discharge matter similar in quality to the original ferment,
mercury

mercury will check and remove the process.

In the small-pox, perhaps, some substance shall be found capable to check that process in the human body which the variolous matter produces.

It seems probable to me, that in the Stone and in the Gout, the stony bodies in the former, and the chalky matter in the latter, are the consequences of the union of a peculiar acid with some earth.

It is supposed, that fixed air is of the nature of an acid. Fixed air exposed to lime-water
causes

causes precipitation, by reason of the particles of lime attracting fixed air, by which it acquires its original state previous to calcination, whereby it was deprived of its fixed air.

It has been observed above, that *hard* water contains in solution a selenetic salt, viz. a neutral salt, composed of vitriolic acid in union with an earth. It has also been observed above, that oil of tartar, *per deliquium*, or other fixed alkali, dropped into *hard* water, causes precipitation of the selenetic earth, by reason of the vitriolic acid quitting that earth and uniting with
the

the fixed alkali, with which it hath a stronger affinity.

Notwithstanding some persons seem more disposed than others to the stone and to the gout, I am of opinion that every person may be liable to both diseases, in consequence of such aliment and drink as leave in the human body that kind of earth, and that kind of acid, which, in union, form the stone in the urinary bladder, and the chalky matter about the joints, of the extremities, especially.

I shall not, in this place, enter into any speculation about the effects of cyder, certain
wines

wines and fermented liquors, containing earth, acid, fixed air, &c. relative to the stone and to the gout; but I shall most heartily recommend to every person having reason to be apprehensive of the stone or gout, and, in an especial manner, to persons labouring under one or other or both diseases, a preventative and method of cure.

Persons having reason to be uneasy about the stone and the gout, and persons really afflicted with those diseases, are requested to make use of an alkaline diet and drink. That I may not, however, be esteemed a rigid counsellor, I will al-

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low

low every gravelly and gouty person to eat whatever best please the palate and agree with the stomach, provided the following drink be always used, viz. ardent spirit mixed with water. To every pint of rum and water, brandy and water, Holland's and water, I would desire that from ten to thirty drops of the *oil of tartar per deliquium*, be added. A solution of any fixed alkaline salt in water, will answer, provided it be equally strong.

The volatile salts in solution, as spirit of hartshorn, sal volatile, &c. might be used with advantage in the proportion of
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one or two spoonfuls to a pint of the above common drink; but that they are apt to increase the pulse, producing feverish symptoms.

If the above diseases be complicated with rheumatism, the volatiles may be substituted, or occasionally used, with great success; and, in this case, such drink is more adviseable towards bed-time.

If any lady or gentleman, so afflicted, use wine, it ought to be old, and of the richer kind; to each glass of which from two to six drops of the oil of tartar

F 2 should

should be added; more or less, as it agree.

In the stone and the gout, the reason why I recommend an alkalescent regimen, will be evident to persons skilled in chemistry; but, for the information of others, I shall just mention that an alkaline salt, thus gradually introduced into the system, will not only very certainly tend to prevent the further formation of calculus and chalky matter, but likewise powerfully tend to decompose stony bodies in the kidneys and urinary bladder, and chalky matter about the joints, in consequence of the fixed alkaline salt uniting with
that

that acid, which, with earthy-matter, forms the stony concretions : for, the earthy matter, meeting now with no acid to combine itself with, passes off by urine, &c. The neutral formed by the alkaline salt with the acid, can assume no concrete mode ; it remains in solution, and passes off in a fluid state by the natural outlets. There is another benefit attending a neutral salt thus formed within the body ; it will promote the excretions, and attenuate viscid phlegm.

Having strayed very strangely and widely from my text, I humbly ask pardon of the reader

for this and every other offence
against *method*.

Upon the whole, then, in respect to common air having many latent properties by which animals are variously affected, according to the opinion of Dr. Lind, and other learned men, I would beg leave to observe, that the common air, like the common fresh water we use at our meals, is healthy or noxious according as the one or the other be charged with foreign matter. If the common air abound with any vapour, which we know to be in the highest degree noxious to animal respiration, whether it be effluvia from vegetable

getable or animal matter undergoing putrefaction; or, the noxious vapour from animals' lungs, or inflammable air, fixed air, marine acid air, nitrous air, or other deleterious fumes; common air, so charged, will produce morbid effects, in a greater or less degree, according to circumstances. It is here to be observed, however, that such fumes and vapours are presumed to become essential component principles of the common air. Were it not for the decomposition of animal, vegetable, and mineral matter, it is to be feared the whole atmosphere would not only soon be rendered unfit for animal respiration,

ration, &c. but become extinct. Fermentation, putrefaction, and combustion are vast sources of common air.

The scurvy has been observed to prevail more upon certain coasts, and in sea-port towns, than upon the ocean; as upon the coasts of the Baltic, the English channel, Norway, and Hudson's Bay. I have again to observe, that in all these parts, seamen especially, drink a great quantity of ardent spirit; which, unless some article of diet supply the body sufficiently with vegetable fixed air, always disposes to, and aggravates the scurvy. It is generally known, and it ought

ought to be universally lamented, that a prodigious quantity of ardent spirit is drank in seaport towns. Nothing can be more destructive to mankind than an improper use of ardent spirit.

If ships and fleets be attacked with this disease, while in harbour, it is because the people are not supplied with such food or drink as yield vegetable fixed air.

I had the honour to serve his Majesty, as surgeon to one of his Majesty's line of battle ships in North America. The fleet, under the command of Admiral A——,

A——, lay a considerable time in Gardiner's Bay; the scurvy and scorbutic flux prevailed on board every ship. Why? Because the poor men were supplied with no food nor drink capable to furnish what the human body so essentially required, vegetable fixed air. There was no scurvy among the officers; why? because the officers drank wine, and nice brisk beer and porter, copiously abounding with fixed air. The officers, moreover had, at times, vegetables and fresh meat: of the latter, when it could be had at the Admiral's terms, as I was informed, the sailors were now and then supplied. It was then

a common report in the fleet, that the Admiral conceived, and said, and affirmed, that salt beef would cure the scurvy. If the Admiral had read and understood the writings of Dr. Priestley, upon the various kinds of factitious air, it is clear, no one would have believed such a conceit could possibly originate in his mind. And it is as certain, if Dr. Priestley had commanded that fleet, he would have saved the King's brave men at the King's expence. While good wines were at that time cheap in New York ; while good beer, good porter, and good cyder, and fresh meat too, might have been purchased in abundance, a
generous

generous philosopher would not have suffered gallant men to perish for want of the vegetable principles so absolutely essential to the preservation and continuance of human health, though a *monarch* might challenge the bill. Economy, in such a case, is truly being a penny wise and a pound foolish. But it is with nations and individuals in the *political*, as it is with animals and vegetables in the *natural* world ; while some are decomposing, others are *fattening* and compounding. Brave, generous hearts ! whose misery I beheld, whose drooping souls I could not comfort, alas ye are no more ! Then what availeth
it

it that I draw upon my poor head the ill-will of a pitiful, sneaking few? It is, because, *misery*, I have *always* a kind tear at thy service; and, *tyranny*, because I would *punish* thee, whose proffered friendship, or swagging menaces, I equally and heartily despise, wert thou ever so great, ever so rich, ever so emblazon'd, ever so escutcheon'd.

My feelings were never more distressed at the sufferings of humanity, than upon that service. We lost many men by the scurvy. With respect to medicines, I tried every one in my possession that I thought
might

might answer, without effect. I consumed a great deal of Peruvian bark to no purpose; the elixir of vitriol was of no use; if it met with any alkaline matter in the stomach or bowels with which it effervesced, the air separated by that process did not answer the end of vegetable fixed air. I resolved to make an experiment at my own expence; I purchased some strong beer in brisk fermentation; I gave of it to six men in an advanced state of scurvy at the rate of one quart *per diem*; at the end of ten days they were wonderfully recovered. The Admiral, indeed, at one time, ordered a supply of lemons. The greater number
of

of what fell to our share I squeezed and preserved the juice in bottles. The supply was not adequate to our necessities; but I took as much care of it as I possibly could, giving it only to sad objects in the last stage of scurvy. The efficacy of the lemon juice was sensibly perceived. Here, by the bye, one cannot help taking notice of the different effects of mineral and vegetable acids: the elixir of vitriol did not answer, but lemon juice did. The air set loose in the bowels by lemon juice, must have been of the nature of vegetable fixed air.

The

The effence of malt, as used in the navy, did not answer. This matter contained the vegetable principles which cure scurvy, in great abundance, but not having previously undergone fermentation, the effence of malt was of little or no service in the cure of scurvy; but, when it had been fermented to such a degree in water that the liquor contained much fixed air, it then effectually answered as well as any other liquor highly impregnated with vegetable fixed air, in consequence of the vinous or spirituous fermentation, would have answered.

All

All vegetable matter, capable of going through the vinous fermentation, abounds with fixed air and phlogiston. Sugar, in an especial manner, abounds with fixed air and phlogiston; but sugar, in its characteristic state, will not cure the scurvy. If sugar be dissolved in water, and some yeast be then added, the vinous or spirituous fermentation will immediately take place in the solution; that is, the sugar then begins to decompose, and the water imbibes its essential component principles, viz. fixed air and phlogiston: in this process a vast quantity of fixed air escapes; but the liquor will not be so sensibly im-

G pregnated

pregnated with phlogiston or ardent spirit till the decomposition of the sugar be nearly effected. The strength of this liquor, or the quantity of ardent spirit generated in it will be in proportion to the quantity of sugar to a given quantity of water, and will depend much upon the manner by which the process of fermentation was conducted. Every body, from the same materials, cannot make equally good malt liquor. There is a something in the conduction of every operation which can only be acquired from experience resulting from actual and habitual practice. Talents for accurate observation and distinction are pecu-

peculiarly requisite in such cases.

If the predisposing causes to scurvy at sea, be not constant but casual, the same observation holds good relative to diseases every where. The climate, the season of the year, the state of the atmosphere, and many adventitious circumstances, contribute to produce morbid effects. But, in fact, I know of no predisposing causes to, nor other causes of scurvy, at sea, but the want of that aliment which supplies the human body with constituent principles, the chief of which at sea is vegetable fixed air. If any additional

G 2 quantity

quantity of phlogiston were required to prevent or cure the scurvy, then grog, or rum and water, or other ardent spirit mixed with water, would be efficacious. Grog, in general, when the ships beer is expended, is served to the people, in lieu of beer or wine, in his Majesty's navy. I have always found that the scurvy was more frequent and inveterate when the seamen were served grog, if they had no article of diet which furnished the vegetable fixed air, as the alimentary vegetables and fruit.

In respect to the weather, it may, I think, be observed in general, that when the mercury
falls

falls below 29 inches, the atmosphere has been diminished by some cause or other. Perhaps it is then in a manner superphlogisticated. When the mercury in the tube of the barometer rises above 29 inches and a half, the atmosphere would appear to me, in general, to be more disposed to receive the inflammable principle. In the former state, the common air is not so fit for respiration, nor so favourable to the decomposition of matter in the state of combustion: in the latter state, animals breathe freely and pleasantly, and fires burn more vehemently and clearly. Scorbutic or other patients will seem

worse in the former state of the air, and better in the latter.

In close, foggy weather, the atmosphere is assuredly diminished; its weight, pressure, elasticity, being evidently lessened, in consequence, most probably of a superabundance of phlogiston; whence it must be less capable to receive any addition of the inflammable principle.

It has been said above, that spirit, oil, wax, or tallow, would seem, in burning, to consist chiefly of phlogiston. If this were strictly the case, the great waste of inflammable substances, as of wood,

wood, pit-coal, &c. in great cities, must phlogistificate, diminish, and render noxious the atmosphere of such places. That this happens, in some degree, cannot be denied; but, when we consider, that the constituent phlogiston of inflammable bodies in the state of fiery decomposition, carries with it, in powerful attraction, other constituent principles of the burning matter, in the form of smoke, which is soon condensed into foot, we shall find that the atmosphere does not receive so much phlogiston from fires and lights, as, at first sight, one might have imagined.

It is believed, by learned men of the present age, that moisture in the air is the *principal and main pre-disposing cause* to scurvy. This is certainly unfounded. Simple moisture, watery vapour, can in no way be a cause of scurvy: if it were so, people in a manner, immersed in watery vapour, from their callings, and people exposed to the fogs of Newfoundland, would, one might imagine, certainly become highly scorbutic. In respect to Newfoundland, while surgeon to one of his Majesty's ships upon that station, I do not recollect any inconvenience having arisen from scurvy; though the atmosphere to a considerable height,

height, is, in general, so loaded with watery vapour, that one can hardly distinguish an object at the distance, frequently, of only 100 yards from the ship. But, on that station, the people are supplied with a liquor impregnated with vegetable fixed air, viz. spruce beer, for their common drink. If, however, a moist air be superphlogisticated, it cannot be so fit for the purposes of animal life.

Damp, wet cloathing and bedding, and lodging in a ship, will not produce scurvy. It is said, such circumstances cause a moist, stagnating, confined, air within a ship, which becomes
most

most offensive and intolerable. Simple aqueous vapour could never produce these effects. Any air which is offensive and intolerable must have been rendered so by other causes: such air is highly noxious; such air is not only superphlogisticated, but the phlogiston is combined with putrid animal vapour, which will always cause diminution of common air, agreeably to the experiments of the great Dr. Priestley. It is certain, that animal life cannot subsist so perfectly in such an air; and a fever, analogous to the plague, or gaol distemper, is more likely to arise from men breathing such air, than the scurvy. Fishermen,

ermen, generally, in all countries, are wet; especially upon the banks and coasts of Newfoundland: but, I have not heard, nor did I see, that scurvy was the result: indeed, few men are more hearty and robust than the fishermen employed in the Newfoundland fishery.

Cold is reckoned a cause of scurvy; the more so if the air at the same time be moist. Dr. Lind esteems cold and moisture to be the most powerful predisposing cause to scurvy. We have now so many proofs to the contrary, that it would be needless to recite them, or offer examples. If men in perfect health,

health, be exposed to any unusual degree of natural cold and simple moisture, while they are supplied with a proper diet of animal and vegetable food, the scurvy will not prevail amongst them. If a moist air, indeed, be so cold as to rob the animal of its vital phlogiston, the consequence would assuredly be fatal: death would immediately ensue, but not from scurvy. A cold and moist air imbibes phlogiston very powerfully and copiously indeed. There is a peculiar kind of dense fog observed in severe frosty weather, which feels remarkably cold: the air in this state is highly disposed
to

to imbibe or combine itself with phlogiston.

If a person be exposed to a sufficient degree of what we commonly understand by the word *cold*, the living principle will be gradually extinguished. The animal so treated will be deprived of all its heat, and all its volatile or vital phlogiston. This vital phlogiston is chiefly confined to the brain, the cerebellum, spinal marrow, and nerves. It is remarkable, that phlogiston does not appear to enter into the constitution of brain, or nervous medullary substance. Brain is altogether uninflamable in a red heat, whence

whence it is certain there is no animal oil, or fat, in its composition.

In respect to the conduction of electricity, Dr. Priestley says, " I may venture to lay it down as a characteristic distinction between conducting and non-conducting substances, that the former contain phlogiston intimately united with some base, and the latter, if they contain phlogiston at all, retain it more loosely."

The vital phlogiston is alleged to be a modification of electric matter; or, rather, the latter is a modification of elementary

mentary phlogiston as well as the former. Now, if vital phlogiston and electricity be similar, the passage I have just quoted would make it appear that the nervous system is incapable to conduct electricity or vital phlogiston, inasmuch as phlogiston does not enter into the composition of brain. But we have much reason to believe the contrary, in respect to vital phlogiston.

The marine acid has a strong affinity with phlogiston. Common salt, mixed with snow, produces a greater degree of cold than the snow indicated: also a solution of sal armoniac
in

in water produces cold. The marine acid attracts, or combines itself with, whatever phlogiston the snow or water could impart, with which it forms a new compound. It cannot be expected, that in this state it should shew itself as phlogiston. Sulphur contains phlogiston in great abundance, but then the phlogiston is so modified in this combination, that sulphur seems as cold as any other substance of equal density.

Common salt in preserving meat from putrefaction may do it in consequence of its imbibing, or *fixing* the phlogiston of the meat.

Bishop

Doctor Watson, in his chemical essays, gives a hint for the decomposition of common salt with a view to obtain natron, or the mineral fixed alkali. I made a violent red fire of pit-coal in the small drawing stove of a parlour. The chimney was narrow, and the fire burned vehemently. I sprinkled by degrees upon this fire about two pounds of common salt. The copious, dense, white fumes, and blue flames, were beautiful indeed. When I thought the purpose might be effected upon the ceasing of the fumes, I suffered the fire to burn out. Lifting up the *blower* of the stove, and looking
H up

up the chimney, I was rather surprized to see, as far up as I could discern, the whole surface covered with white matter. This appearance must have been produced from the union of the marine acid with the phlogiston of the fire. I threw my ashes into water, which I filtered and evaporated, when I obtained part of the common salt which I had sprinkled upon the fire. There was no natron.

I made this experiment in the month of June. It is to be remarked, that a tree in the garden suddenly lost all its leaves. This tree was exposed to the white fumes, which issued
out

out of the chimney in vast abundance. Quere, Was this phenomenon occasioned by the marine acid depriving the leaves of the tree of their phlogiston?

Nitre, given in inflammatory diseases, is of great use, inasmuch as its acid may imbibe, or combine itself with the phlogiston of animal heat; of which, in inflammatory cases, there appears to be a superabundance. We know the great affinity there is between the nitrous acid and phlogiston.

The *calces* of metals appear to be highly disposed to imbibe phlogiston. Quere. Is the ex-

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tract

tract of saturn of use for this reason in topical inflammation? if so, as the calx of lead soon acquires an additional weight, would it not be more efficacious if used before it has had time to become heavier?

Living heat, or animal heat, and vital phlogiston, are very different things. Animal heat is diffused throughout the body in consequence of the circulation of the blood. How living heat is generated, God knows. In a limb completely *frost-bitten*, in consequence of its having been robbed of all its sensible or warm phlogiston, there is not only a cessation of
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the circulation of the blood, but the vital phlogiston, or nervous influence is no longer propelled; the conducting power of the nerves of such limb would appear to have suffered some change; whence the limb continues cold and paralytic, and, in fact, is dead.

Animal heat, in a part, would appear not to depend upon the nervous influence being propagated in that part; for, in palsy, the animal or living heat of the diseased limb will be found equal to that of the sound limb. Animal heat would appear to be always increased in proportion to the increase of

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the circulation of the blood. Animal heat does not depend upon muscular action, that of the heart excepted. In inflammatory fever, while the moving or muscular system is inactive, the animal heat is increased. Animal heat, and that heat which is produced by the friction, motion, percussion of dry solid bodies, would appear to be different relative to their cause.

But to return. If seamen and officers have constantly dry cloathing and lodging, on ship-board, while they are deprived of such diet and drink as yield the vegetable principles, they will

will most assuredly be sooner or later attacked by scurvy.

A squadron of his Majesty's ships, under the command of Rear Admiral Graves, sailed from Plymouth Sound in the month of May, 1780, for North America. I was surgeon to one of these line of battle ships. We crossed the Atlantic Ocean, for the greater part, in about the latitude of 30 degrees, north. The weather, during the whole passage, was remarkably fine and dry. No people could be more healthy than the crews of all the ships of this squadron, while they drank the ship's small beer.

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When the beer was expended, the people were served with rum and water. In a short time thereafter the scurvy began to shew itself. It prevailed rapidly on board of our ship, and we lost several men. When the ship arrived off Sandy-Hook, we had about one hundred men miserably afflicted with the true marine scurvy. The other ships suffered in proportion. The bark, the elixir of vitriol, the essence of malt, were of no service. I remarked, that the fresh, hale, country young men, who had entered as landsmen and marines, and who had never before been to sea, suffered most; the scurvy spread rapidly

rapidly throughout their system.

Moist sea air, Dr. Lind says, is rendered still more noxious by stagnation, whereby it loses its elasticity, and is prejudicial to animals, and more so where stagnating water is pent up along with it; and it is heated in ships by passing through the lungs of many people, and impregnated with various effluvia.

Now, I would observe, that the common air by stagnation, will be affected according to the nature of the substances with which it is in contact. As matter in general would seem to be
always

always in a state of change, some substances will diminish common air, while others render it more pure. Some substances, as animals, will diminish its good qualities by excrementitious vapours, while others, as growing vegetables, are purifying it by absorbing such excrementitious vapours. In a ship, and in every close place which is crouded, the common air will become less pure; more impure if many candles be constantly burning between decks and in cabins, &c. below. Air in a ship at sea, is likely to be less purified than air in country houses; for Dr. Priestley has proved, that vegetables (during

a

a certain period of their growth) absorb the noxious qualities of air. Such a mode of the purification of air cannot, of course, exist at sea. But, as Dr. Priestley has also found that pure water imbibes impure qualities of air, the ocean is supposed useful in this view: and more so, perhaps, than fresh water.

Mere stagnation will not render the common air noxious. A very clean and dry bottle filled with common air, and hermetically sealed, will preserve such common air for ever; but if any active vapour were admitted,

mitted, the quality of the common air would be changed.

Acid, and alkaline air, produce phenomena upon the same principle as alkaline salts and acids do. An acid air and an alkaline air will effervesce in the act of union, exhibiting various coloured fumes, and sometimes efflorescences. Volatile alkaline fumes, exposed to nitrous air and common air mixed, causes white clouds; the nitrous vapour uniting with the alkaline fumes, while the common air receives the phlogiston with which the vapour of the nitrous acid was combined.

I have

I have found that the vapour or fumes of the nitrous acid diminish the heat of the common air. Is it not probable that the fumes of the nitrous acid combine with the aërial phlogiston?

Nitrous air added to, or mixed with, common air, effervesces with one or other of the constituent principles of common air; and this effervescence and diminution of the quantity seem to be in proportion to the purity of the common air. Nitrous acid has a strong affinity with phlogiston. Is it possible that the nitrous acid fumes should have a greater affinity with the
aërial

aërial phlogiston, than with the phlogiston of metals? If so, nitrous air may decompose common air by uniting with the aërial phlogiston, while some constituent principle of common air imbibe or unite with, the metalline phlogiston.

Nitrous air, Dr. Priestley has found, will not effervesce with inflammable air, nor with any kind of diminished or noxious air; and all noxious air is supposed to be rendered so by foreign phlogiston. Might we suppose that nitrous air effervesces only with the aërial phlogiston, or that peculiarly modified phlogiston which enter into the constitution

constitution of common air? If a pint of nitrous air be added to one gallon of common air, there will happen an effervescence and an appearance of " a turbid red, or deep orange colour and a considerable heat ;" that is, the nitrous acid decomposes the common air in such a way as to unite with the aërial phlogiston, setting loose fixed air, which is a constituent principle of common air. The whole quantity of air thus treated has been found by Dr. Priestley to be diminished more than one third. How shall we account for this diminution of common air by its having been mixed with, and decomposed

decomposed by, nitrous air? Is ærial phlogiston the cause of the spring, the elasticity, and expansive power of the atmosphere? But, indeed, principles decomposed cannot be imagined to be capable to shew the same phenomena as when in a state of union. In separation they will act most oppositely. A neutral salt is formed by the union of an acid and an alkaline salt. Which qualities can be more different than acid and alkaline? and how different is a neutral salt from either an acid salt or an alkaline salt.

The fact would appear to be this: nitrous air, consisting of
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the nitrous acid fumes saturated with metalline phlogiston, obtained by pouring nitrous acid upon metals, mixed with the common air, the phenomena take place for this reason; because the common air having a greater affinity with the phlogiston of the metal than the nitrous acid fumes have, powerfully and instantaneously absorbs, imbibes, or unites with it. It appears probable, that in this process, the common air lets loose its fixed air, as is the case when inflammable or putrid air is mixed with common air. If so, fixed air would appear to be the principle of elasticity in common air; for, when com-

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mon air lets loose fixed air, it becomes diminished. How expansive does fixed air become in bottled beer, &c. ! Nay, is fixed air common air condensed ? I believe water is incapable of decomposition. Is it so with common air ? Water becomes poisonous when poisonous matter is mixed or dissolved in it : and the common air will become noxious if noxious fumes, vapour, exhalations, be mixed with or dissolved or diffused in it.

Plants live in inflammable air, and thrive wonderfully in putrid air, according to the experiments of the great Dr. Priestley. But, plants will not live in air deprived

ed of phlogiston. I have had plants in pots of earth at sea : Whenever the spray of the sea fell upon their leaves they died quickly. The marine acid, I apprehend, robbed the plants of their constituent phlogiston. Plants will die in nitrous air, and in common air which has suffered diminution, or decomposition by nitrous air. Metal-line phlogiston is perhaps unfit for vegetable nourishment.

A principle, an element, may be modified; but, can a principle, or an element be decomposed? I should think not.

Further, in respect to the nitrous acid. The nitrous acid, not only combines itself with fiery phlogiston, but dislodges and forms an union with it in its fixed and cold state. The nitrous acid forms an instantaneous union with the phlogiston of sulphur and charcoal in the burning of gun-powder. The nitrous acid attracts the cold fixed phlogiston of metals, thereby decomposing them. Might not the nitrous acid, diluted, be more useful in inflammatory cases than nitre, to absorb superabundant phlogiston? Yet, if what I conceive to be the case be founded in respect to neutral salts formed by the marine, nitrous,

trous, and vitriolic, acids, combined with alkaline basis, it is a matter of no great moment. The marine acid, the nitrous acid, the vitriolic acid, have a strong affinity with phlogiston; more so than with alkaline basis. I conceive when sea water or salt water is taken in that quantity which will purge, or in any quantity, the sea salt is decomposed; that is the marine acid quits the natron, its base, and combines itself with animal phlogiston. Thence the use of, and advantage from, seawater, or sea-salt, in certain inflammatory cases. The alkaline basis of sea-salt, I think, neutralizes itself by an union with

some acid in the animal body,
and proves purgative.

Glauber's salt, or that neutral salt formed by an union of natron or the basis of sea salt, and the vitricolic acid, I conceive to undergo a similar process, and to produce similar effects. Whence also the use of Glauber's salts in inflammatory complaints.

I would say the very same of nitre, only with this difference; that salt-petre is seldom given in such quantity as, when its basis (fixed alkaline salt) is neutralized, or, saturated, with an animal acid, to purge.

Whence

Whence is it that sea salt and saltpetre preserve flesh from putrefaction? as I have observed, because the marine acid of the former, and the nitrous acid of the latter, would appear to combine with, or to fix, the phlogiston of the meat: for, it would appear, that putrefaction is the consequence of the constituent, or fixed phlogiston, and fixed air, of animal and vegetable matter becoming active, volatile and expansive; and, undergoing a different modification, they detach themselves from other constituent principles of animals and vegetables, and escape into the common greedy receptacle, the atmosphere. A-

nimal substances begin soon to decompose or putrefy in warm climates ; and when that process once begins, it is no easy matter to check it ; whence the great difficulty, by common means, to preserve animal substances from putrefaction in warm countries, or, in hot and sultry weather.

Unless aliment supply phlogiston and fixed air, it cannot nourish nor preserve animals alive. It is in consequence of vegetable phlogiston in grass, hay, oats, &c. that sheep, deer, oxen, horses, &c. become fat : and it is in consequence of the same principle

principle animalized, and vegetable fixed air, which the above substances yield, that animals are muscular and powerful. In proportion as hay abound with its constituent phlogiston, the more valuable it is esteemed. Well preserved old hay is for this reason always dearer than new hay. One ton of old hay may be worth two tons of new hay in point of nourishment. Old hay has lost its watery parts which made great part of its bulk and weight when new. Old hay, well preserved, retains, in great abundance, phlogiston and fixed air.

Old

Old people require a greater supply of phlogiston than young people; but this supply of phlogiston should be obtained rather from aliment in the course of digestion than from liquors highly charged with phlogiston; as wine, brandy, rum, &c.

Vegetable food is far less nourishing than animal food. Animal food is vegetable principles animalized; consequently a less quantity of animal food will nourish men than a greater quantity of vegetable food: wherefore, where quantity and *flatulency* offend, animal food is to be preferred, in all cases where
quick

quick nourishment is required. Animal food moreover, is more easy of digestion than vegetable aliment in general. Animal food communicates the vegetable principles *animalized* quickly, and in greater abundance, than vegetables can possibly communicate them in the course of their digestion and assimilation in the animal body. For this reason, the drink vulgarly called *Flip*, viz. brandy or rum mixed with beer highly impregnated with fixed air, is a most nourishing drink, and sudden cordial in cases of fatigue and debility from any excess of bodily orgasm. I purposely omit to mention eggs and sugar, &c.

com-

commonly added to this drink*; but I would just desire that the beer might not be heated; otherwise the vegetable fixed air would all escape, and the liquor would become flat and vapid. Such a drink, with all the ingredients if you will, I conceive to be highly proper in old age; provided always in every case of this kind, the liquor be neither too strong nor taken in too great a quantity, nor too frequently repeated. The abuse of any blessing renders it a curse. The abuse of wine and spirits,

* Because I confine myself to the nourishing vegetable principles, phlogiston and fixed air; the former in the ardent spirit, and the latter in the beer.

or

or inebriating liquor, is tedious, but infallible ruin, and self-murder.

The great and celebrated Dr. Priestley says, " I cannot help flattering myself that, in time, very great and medicinal use will be made of the application of these different kinds of air to the animal system. Let ingenious physicians attend to this subject, and endeavour to lay hold of the new *bundle* which is now presented them, before it be seized by rash empiricks; who, by an indiscriminate and injudicious application, often ruin the credit of things and processes which might otherwise make an useful

useful addition to the *materia* and *ars medica*." The Doctor previously says, "being no physician, I run no risk by such proposals as these."

In respect to myself, I would beg leave humbly to signify that, being neither physician nor quack, I *hope* to run no risk by what I shall have observed, and caused to be printed and published upon the subject. Being but a gentleman soldier in the ranks of the medical army, I hope no commissioned officer will shake his cane over the head of a poor *private* for presuming to *think*, and to deliver opinions relative to his profession.

I have the honour to know Dr. Priestley but from his writings; where I clearly discover a *mind* too great to be offended at any thing I shall have said; and where I plainly perceive a *heart* too benevolent *not to soften* and *pardon* the errors, the inadvertencies and the ignorance of a brother subject and fellow creature.

In respect to the medical application of the various kinds of *factitious* air, I would observe,
 1. That in cases which require fixed air, viz. *putrid* cases, it appears to me, that the best way to administer fixed air will be found to be by liquors highly impreg-

impregnated with fixed air in
 consequence of the vinous or
 spirituous fermentation. I would
 prefer such liquors to any water
 charged with the fixed air of
 minerals. Beer so brisk that it
 bursts bottles will effectually
 convey more genuine vegetable
 fixed air into the bowels than
 any other contrivance. I would
 rather, at all times and occasions,
 wish to evacuate putrid fœces
 from the system, than saturate
 such noxious matter with fixed
 air. If it shall ever be judged
 necessary to inject fixed air into
 the bowels, I think it should
 be communicated by such li-
 quor as I have mentioned. Per-
 haps an injection of fresh yeast
 might

might do great good ; especially if gangrene be apprehended. It must be observed, that all liquors highly charged with fixed air from fermentation ought to be administered quickly in their natural cold state. The application of heat would expel their fixed air.

2. Inflammable air. In cases of sudden or apparent death, inflammable air might be injected into the intestines : and, here, as a desperate case often requires a desperate remedy and treatment, if we could cause inflammable air to fire and explode, I know not what might be the consequence. Upon the whole,

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it would appear, we are in possession of more eligible and more effectual stimulants. Electricity might be more successful.

3. *Nitrous air* ; or, the fumes of the nitrous acid charged with the phlogiston of metal. I cannot very clearly discover how nitrous air may operate. If nitrous air be injected, I should apprehend some sudden decomposition of it. I would trust more to the nitrous acid given in a diluted state ; or to nitre itself, in all cases where nitrous air might be useful. We have certainly more eligible ways of giving phlogiston. I apprehend the phlogiston

giston of metals would be prejudicial, instead of being salutary, to the animal constitution.

4. *Marine acid air.* I would prefer the acid diluted in water. It will be found in able, judicious, and distinctive hands, a most valuable remedy in inflammatory and real putrid distempers. The marine acid, or its fumes, absorb phlogiston most powerfully indeed; whence it will abate inflammation, and check any tendency to animal putrefaction.

The fumes of the marine
acid combined with the phlo-
K 2 giston

giston of certain vegetable matter, smells in a peculiar manner, which is suffocating and offensive in the highest degree. Such fumes prevail in great abundance on board of West-India ships in the sugar trade. The drainings of molasses from the new sugar mix with the salt water in the ship's well, where, fermenting, the marine acid combines itself with the phlogiston of the saccharine matter. These fumes arise copiously, and are diffused throughout the ship. The surfaces of all exposed solids in the ship are tinged with these fumes; so that every thing looks as if it were

were coloured with some shining black lead.

With a view to correct bad air in a ship, and to destroy infectious matter, a custom prevails in his Majesty's navy to burn combustible substances between decks, &c. to fire gunpowder, to deflagrate saltpetre, with burning charcoal, &c. Now, from all the experiments of Dr. Priestley, it would appear, that such a practice must render bad air worse. A candle will not burn in air in which gunpowder has been fired: and if the same bad air were always to remain in a ship, by such a treatment it would be rendered

very noxious indeed. But, as in every confined place containing many men, there must be a continual supply of fresh air, admitting the above practice to do good, how shall we detain the air we suppose thus to be purified? If, during a windy day, a man make a fire upon the top of a hill, and tell me he does so to purify the air about him, ought I not to pity his head?

But, and it is a happy and most valuable discovery, Dr. Priestley proves demonstratively, that by agitating the most noxious air of any kind in water, the noxious air is purified.

fied. Instead, therefore, of burning tar, pitch, old rope, charcoal, saltpetre, gunpowder, &c. in ships of his Majesty, or in other ships, if a machine were contrived to disperse water in beautiful showers, between decks, and in confined places, where no injury thereby might be done to stores, the air in such places would, *pro tempore*, be rendered pure; after which, the water having been dried up, the surfaces of solids may be bathed or moistened, or done over with some strong acid; acids, especially having a great affinity with phlogiston. In their concentrated state, however, such acids would injure the consti-

tution of many substances ; this is to be obviated by diluting them with water.

That there must be a constant supply of fresh air in a ship, containing men, is very certain : and that men and burning candles consume, or, rather, render noxious, a vast quantity of common air, is equally true.

As every man, and every burning candle consumes about one gallon of common air in a minute, if a ship contain one thousand men, one thousand gallons of common air will be rendered noxious by these men every minute, and sixty thousand

and gallons of fresh air will be required every hour for their preservation. A prodigious quantity indeed; besides the air consumed by burning candles and live stock, which will be in proportion to the numbers respectively. How dangerous, how dreadful must it be, where many men are shut up within the scanty limits of a ship, even in the purest state of the common air; how much more so must it be while the atmosphere is super-phlogisticated and charged with watery vapour? Pestilence, in such circumstances, may be apprehended; or, which is tantamount, a rapid tendency to putrefactive decomposition
of

of the animal constituent principles, when the vital powers vanish quickly and sadly indeed. For which reasons ships cannot be constructed too large and airy, in this view. When it happens in stormy weather, or from any pressing occasion, that the ship's hatchways are obliged to be shut up and *battoned* down, too much attention cannot be bestowed to sweeten the ship immediately afterwards. Even at times, when the hatchways have been uncovered, I have seen, in line of battle ships, in the morning, the frames of the hatchways covered with a kind of mouldy efflorescence, occasioned by the breathing

breathing of the men below.
Fixed air causes a mouldy efflo-
rescence.

When I was surgeon to his Majesty's ship *Conquestadore*, then stationed at the Nore, to receive impressed men from tenders, &c. I have received poor wretches under my care by the tender from the Tower, in the most pitiable condition. The method is to shut up sixty or eighty ill-fated mortals in the hold of a small vessel, where they are sometimes, as it were, stowed *in bulk*. The hatchway, if the men become *troublesome* for want of common cool air, is at times, hermetically sealed. As they are not suffered to come
upon

upon deck, to answer the calls of nature, there is a tub or a bucket placed below in the midst of them. The effluvia from human excrement must, of course, add greatly to the misery of *Britons* so treated. Under such circumstances many faint, and some die: others have been received on board the guardship with fever that has immediately exhibited putrid phenomena, terminating in death. These wretches, after having been 18 or 20 hours thus confined, look as if they had come out of the black hole of Calcutta, with cadaverous countenances, drenched with sweat and the vapour of the breath, and

and reeking with heat. I have seen human nature undergoing severe discipline in various countries, barbarous and polished; but I do not recollect to have seen my fellow creatures any where in a more unpleasant situation, than I have seen the subjects of a nation so justly renowned for magnanimity, benevolence, and pity, on board *British* tenders. It is said the urgency, the exigency of affairs require it. It may be so; and I bow down with reverence, though unconvinced. O for the purse and the *power* of an absolute monarch, and a royal mandate to travel throughout his dominions in quest of human

man

man woe; to faturate the wants of wretchedness, in stations beneath the notice of *unfeeling* affluence and gaudy *giddy* blazonry; and, above all, O for the purse and power of Majesty, to reward, in the *gentlest* and most *delicate* way, that *suffering* glory of humanity, which, like Patience on a monument, *smiling* at grief, *nobly* perishes in some lone retreat, a triumphant and splendid sacrifice to the dignity of our nature, rather than say *thank you*, to all the monarchs upon earth.

Dr. Lind says, " an additional, and extremely powerful cause, observed at sea to occasion

tion *scurvy*, and which, concurring with the former, in progress of time, seldom fails to produce it. And this is, the want of fresh vegetables and greens; either, as may be supposed, to counteract the bad effects of the before-mentioned situation of seamen; or rather, and more truly, to correct the quality of such hard and dry food as they are obliged to make use of. Experience, indeed, sufficiently shews, that as greens, or fresh vegetables, with ripe fruits, are the best remedies for it, so they prove the most effectual preservatives against it. A want of them at sea, together with a long confinement within
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the narrow limits of a moist damp ship, are the true causes of its so general and fatal malignity upon that element."

When Dr. Lind wrote his thoughts upon this disease, the Scurvy, the pneumatic discoveries of Dr. Priestley were not published. If I had not read and understood Dr. Priestley's writings, and repeated, and perhaps varied many of his experiments, relative to the different kinds of factitious air, whatever I might have published upon the scurvy would have been greatly inferior to the observations of Dr. James Lind. Indeed, even now, whatever
may

may deserve attention throughout these pages, can confer no merit upon me; for I am indebted to the works of Dr. Priestley for the greater part, the *essential* part of the knowledge I may be allowed to have upon the present subject. If I had not read his book, I should never have written what this little book contains. I hope I shall not have done it altogether in vain.

Fresh vegetables, greens, and ripe fruit, will effectually prevent and cure the scurvy: but the scurvy will be effectually prevented and cured, without fresh vegetables, without greens,

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and

and without ripe fruit. But the sea scurvy cannot be prevented, nor cured, without the vegetable principles, viz. vegetable fixed air and vegetable phlogiston. Whatever vegetable substances, or liquors, abounding with fixed air, be most disposed to part from their fixed air, when taken into the bowels, are the substances and liquors which will have the greatest and quickest efficacy in the prevention and cure of the scurvy.

Vegetables and fruit are of use in the prevention and cure of sea scurvy in proportion as they abound with fixed air
and

and phlogiston, and as they be disposed to yield those principles in the stomach. Although flour abound both in fixed air and phlogiston, yet flour, in the forms of sea biscuit, such as the King's ships are supplied with, and sea puddings, lays heavy upon the stomach, because it does not readily digest, or decompose or yield up its constituent principles by that kind of fermentation which takes place in the human stomach, unless it meet with some proper yeast or ferment in the stomach, when it will quickly digest or be decomposed. Without fermented liquors, or liquors highly charged with fixed air by

fermentation ; or without vegetables and fruit ; in short, without vegetable fixed air, as a ferment, sea biscuit and puddings are very indigestible in the stomachs of seamen, especially if they be afflicted with scurvy. The same observation is applicable to many vegetable substances which will not decompose in the stomach, though we well know they abound with fixed air and phlogiston in the course of the vinous or spirituous fermentation. The essence of malt, for this reason, simply dissolved in water, and taken into the stomach, will by no means readily yield up its fixed air and phlogiston : but,
if

if we dissolve essence of malt in water, and add some yeast to the solution, a vast quantity of fixed air will separate, become elastic, and fly off the fermenting liquor, which becomes highly impregnated with fixed air. It is in this manner that essence of malt ought to be treated and used on board his Majesty's ships.

Sugar, which, I think, abounds more in vegetable fixed air and phlogiston than any other vegetable substance I know, except oil and turpentine, will not, in any considerable degree, part from its fixed air in the stomach spontaneously ;

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but

but no sooner do we melt sugar in water and add yeast to the solution, than the fermentation, decomposition, and discharge of its fixed air take place. In this operation, though the phlogiston be detached, it does not fly off like fixed air. It appears to acquire a new mode, and unites with the water, thereby rendering it spirituous.

We have been taught by Dr. Priestley to impregnate water with fixed air obtained from chalk, by the vitriolic acid. Water thus impregnated, has been found not only to possess the qualities of the Pyrmont and Seltzer waters, but even to surpass

surpass them in flavour and brilliancy. For my own use I impregnate water with fixed air in another manner, which I shall mention by and by.

The late Dr. Hulme has recommended fixed air for the prevention and cure of the sea scurvy. He advises the medical gentlemen, and others, at sea, to have in readiness an alkaline mixture of water and salt of tartar, and an acid mixture of water and the weak spirit of vitriol. He directs a certain quantity of each of these mixtures to be taken into the stomach separately, the one immediately after the other, so that

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in the stomach they may effervesce and discharge fixed air.

I am not certain that it is so; but I think I have perceived the mineral fixed air and the fixed air obtained from vegetable matter to be different in flavour and taste. I am certain that equal quantities of the same kind of water equally impregnated, the one with fixed air obtained from chalk and oil of vitriol, and the other with fixed air from a fermenting liquor, differ widely in smell and taste. Vegetable and mineral fixed air may only differ in modification.

I im-

I impregnate water with fixed air in the following manner. I have lately been in the habit of drinking a small fermented liquor made from sugar. I dissolve fifteen pounds of sugar in ten gallons of water, and set the mixture to ferment in a ten gallon cask. I put about half a pint of yeast to the whole. When the fermentation has taken place, I adapt a bent tube to the bung-hole, in such a manner, that all the generated fixed air must pass through this bent tube. The other end of the bent tube is introduced and immersed into a large bottle two thirds full of fair water. In twelve or twenty-four hours,
the

the water in the bottle will be strongly impregnated with vegetable fixed air*. But, finding that my *small beer* made from sugar contained fixed air in much greater abundance, I thought it quite unnecessary, for my own use, to be at the trouble of impregnating water with vegetable fixed air in the above manner. I therefore draw off my liquor into bottles, which I take care to have well

* It is to be remarked, that the inside of a glass tube used for this purpose, was coated throughout with yeast in 24 hours, although the perpendicular part of the tube, from the bung to the first bending, measured two feet. Quere, Is yeast fixed air condensed? or, rather, can fixed air be modified into yeast?

corked.

corked. When I draw a cork, I have not only good saccharine small beer, but a most healthy and brilliant beverage for my common drink, highly charged with vegetable fixed air.

One might imagine, that as fixed air is obtained by pouring oil of vitriol upon chalk, in water, that the vinous or spirituous fermentation, is an effervescence resulting from the operation of a similar process. This is a mere loose idea of my own.

Sea diet, or ship's provisions, Dr. Lind says, are extremely wholesome for labouring people,
or

or persons in perfect health, using proper exercise in a pure air; in such circumstances he adds, seamen will live upon it for several years without any inconvenience.

Certainly, provided such labouring people, persons in perfect health, and seamen, be properly supplied with vegetable principles, otherwise, as I have observed, they will be very liable to scurvy, in spite of proper exercise and pure air. It is of no moment whether these principles be supplied by vegetables themselves, by fruit, or by fermented liquors. The latter will be found a perfectly adequate

adequate substitute for the former.

I have always observed, says Dr. Lind, that the scurvy increased in violence, upon the ship's small beer being exhausted and having brandy served in lieu.

This is a truth confirmed by the death of thousands of brave men; many of whom, if they had been supplied with vegetable principles, would have been now alive and merry; ever ready to stand forth in the defence of their king and country. Alas, magnanimous souls!

The

The sea diet, in general, says Dr. Lind, is extremely hard of digestion : it consists of two articles, viz. unfermented, mealy, or farinaceous substances and salted or dried flesh and fish. Sea biscuits, glutinous pasty, puddings, ground oats boiled in water, boiled peas, salt butter and cheese. No person, the Dr. observes, can live long on a diet of such salt flesh meats, unless it is corrected by bread, vinegar, or vegetables.

Beer and fermented liquors of any sort, says Dr. Lind, will be found the best antiscorbutic remedies, and most proper to correct the ill-effects of a sea diet

diet and situation; whereas distilled spirits have a most pernicious influence on this disease.

A vegetable ferment is certainly necessary for the proper digestion and assimilation of such substances in the human stomach. New fermented bread will answer in some, not small, degree. Vinegar, though it correct tendency to putrefactive digestion, yet I have not found, in the course of some years practice on board his Majesty's ships, that it answered as a preventative or cure, in any degree, which might authorize me to recommend it in the scurvy, so as to be relied upon.

New

New fermented bread and vegetables, so essentially required at sea, in default of fermented liquors, it is inconsistent to suppose we can be supplied with upon the ocean.

The unfermented, mealy, or farinaceous substances ; the sea biscuit, the glutinous puddings, the boiled pease, the oatmeal, contain the vegetable principles abundantly. They require nothing but vegetable fixed air from fermented liquors or vegetables, to render them easy of digestion ; when they will yield up their constituent principles.

What

What Dr. Lind has said above, concerning beer and fermented liquors, is, in brief, the sure method of preventing and curing the scurvy on board ships, at sea, or any where. Twenty folio volumes upon this subject, in a practical view, could not be more to the purpose. If the pneumatic doctrines of Dr. Priestley had been known to Dr. Lind, when he writ his very excellent book upon the scurvy, it would have appeared, probably, in a smaller compass, still clearer, more philosophical, more intelligent, and containing fewer doubts and round-a-bout enquiries.

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Ardent

Ardent spirit, as it tends powerfully to fix the constituent principles of vegetable matter and animal substances, must, surely, “ have a most pernicious influence on this disease;” for, fixed air being wanting, it will impede the digestion of sea aliments, and induce hectic fever.

Dr. Lind says, when seamen begin to suffer from the sea diet, they long with the most craving anxiety for green vegetables and the fresh fruits of the earth; from which only relief can be had.

The

The former part of the above is generally known to be fact; but, the conclusion is so far unfounded, inasmuch as fermented liquors, containing the vegetable principles, grant the same relief.

In Dr. Lind's book it is observed, that some thousands of Saxons were cut off, at the siege of *Thorn*, by the scurvy. They had been exposed to all its causes. This was a real scurvy; and no sooner the gates were opened, and plenty of vegetables admitted, upon the surrender of the town, but the disease quickly disappeared, after

M 2 having

having occasioned a very dreadful mortality.

New beer, ale, cyder, porter, wine or other fermented liquors, impregnated strongly with fixed air, and charged in some degree with vegetable phlogiston, would have been found to have answered the same purpose: and this assertion perfectly coincides with what Dr. Lind has said elsewhere.

In Lower Saxony, parts of Germany, Sweden, Denmark, and Norway, the scurvy is observed to be much less frequent than it was formerly; the face
of

of all these countries, and the manner of their living, being much improved within these last 200 years. They now drink wine more freely, brew better ale, live in drier, and more airy, commodious houses, and have greatly drained and improved their lands: notwithstanding which, Dr. Lind thinks, that the *cold* of the climate must have certainly contributed a great deal towards the production of scurvy; for, says he, at Venice, whose situation is as damp as most places, the disease is unknown.

It is to be considered, that the Venetians drink wine, and

M 3 eat

eat excellent fruit. I have said already, that cold and dampness will not produce scurvy; causes of a different nature are required to produce it.

In addition to my remarks upon *cold*, I introduce the following observations :

In clear, frosty weather, the atmosphere of cold climates would appear to be highly in want of phlogiston. How greedily does the common air receive the bluish flames, inflammable air, phlogiston, from our fires, which burn with more than ordinary violence in a keen frost, when the mercury is in a rising

rising state; and how powerfully does the common air, in such a state, rob animals of their heat, especially whose skins are not covered with hair, wool, or fur. Grease would seem to confine animal heat; whence a reason why fat people bear cold better than the lean and meagre. In a frosty day, while I walk, *shivering*, with a lusty gentleman, he shall be *puffing*, and wiping his face.

The fat of animals, done over upon the face, hands, &c. in frosty weather, would seem to confine the animal heat in those parts, preventing delicate skins from chops, cracks, &c.

M 4

Oiled

Oiled silk will confine animal heat effectually.

Hair certainly prevents animal heat in a great measure from flying off, upon the application of cold air. In cold, northern regions, the hair and fur of animals are free from grease externally. Quere, Do pomatum and hair powder favour the escape of animal phlogiston from the head? I think they do; at least, using both, my head feels as if it were so in very cold air. Hair perfectly clean and dry will keep the head warmer than hair em-plastered with pomatum and hair powder, in my opinion; but,

but, be that as it may, philosophy will politely yield, in such cases, to fashion and habit.

When any excretion is checked, nature generally has a resource. If accustomed perspiration be checked by very cold weather, we are apt to make more water, and discharge more aqueous vapour by the lungs. In tender constitutions, in order, as much as possible, to spare the lungs, the body should be kept warm; for which reason flannel sheets, flannel shifts and shirts, flannel under-waistcoats, petticoats, &c. are peculiarly required during the cold and damp seasons

sons of this climate. Because the Dutch observe this practice, it would appear that very few die of consumption in that country, in proportion to the number carried off by it in Great Britain. The perspiration from the surface of the body should be always, in cold and damp countries, particularly encouraged. We should, thence, accumulate animal heat, and, among other reasons of greater consequence, have less occasion to mangle and burn our skins by the fire-side.

Very cold air is, in many cases, unfavourable to the respiration of animals. Very cold
air

air greedily receives the phlogiston and putrid effluvia combined therewith from the lungs of the respiring creature, but the excrementitious, aqueous vapour is not so readily and completely discharged. Very cold air does not receive such vapour, so as to retain it in solution, as is the case in warm weather, when we cannot see the breath. In cold air the watery vapour comes out of the lungs in dense fumes, which are not taken up in solution by the common air, but are condensed and precipitated in it. Very cold air is capable to condense the watery vapour in the lungs. There is, in many constitutions, during very cold weather,

weather, an accumulation of such vapour in the lungs; which vapour would seem to suffer a kind of coagulation, causing a degree of anxiety, oppression, and cough, till it be expectorated in the form of phlegm, sometimes tough and viscid. Quere, Is such coagulation effected by phlogiston in the lungs? Lymph and serum coagulate by heat.

In such a cold state of the atmosphere, all quiescent matter whatever, upon the surface of the earth, in such regions, is robbed in a greater or less degree, according to circumstances of density, &c. of its heat,
of

of that phlogiston which does not immediately enter into the constitution of matter in a fixed mode. But, a cold atmosphere would even seem to rob organized matter of constituent phlogiston. The vernal blights, in consequence of which, not only vegetables we esteem tender, but also trees perish, may, probably, be the result of either a defect of phlogiston in the common air; or, the common air suddenly and powerfully attracts the phlogiston of their buds and tender leaves: nay, the very trunk of the tree shall die by a blight. May a blight be owing to any acid vapour in the air, which have a strong affinity

affinity with phlogiston, as the marine acid, the *nitrous* acid, the vitriolic acid?

A shock of lightning is fatal to a vegetable or an animal, inasmuch as, I conceive, it unites with and carries off, in an *electricity*-state, the vital phlogiston of the plant or of the animal.

The lustre, and the life, and the eloquence of the eye, depend upon vital phlogiston. In the moment of death we see the vital phlogiston, as it were, vanishing from that organ. When the sturdy, the honest ox, recoils, falling for ever, from
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the fatal stroke of the murderous hammer, how inexpressibly shocking it is to see his dying eyes! How changed!

There is a certain degree of energy peculiar to every organ of an animal in perfect health. If the energy of any one organ be diminished, or increased, morbid phenomena will occur. If the energy of the stomach be lessened, loss of appetite and indigestion may be the consequence. If the heart and arteries lose their energy in some degree, a languid circulation and its consequences, will prevail. If the energy of the brain be diminished in any degree, the

the whole system will be deranged. A person much depressed and exhausted by labour sits down with his friends over a bottle. He drinks of liquor containing much phlogiston till he be half inebriated. In the progress of this refreshment, we observe a gradual elevation of spirits, from dejection to a degree approaching to madness. He was unstrung and feeble; he is now braced, powerful, and vigorous. He is all alive; he is, in fact, superphlogisticated vitally and corporally: he has an uncommon degree of muscular exertion; the circulation of the blood is universally increased, and, of course, his animal heat.

heat. In this state, the brain, cerebellum, and medulla spinalis, are overcharged with vital phlogiston. The blood contained phlogistic materials in too great an abundance, and the secretion of vital phlogiston was supernaturally copious; of which, any accumulation in the brain and cerebellum, beyond the natural quantity, might occasion apoplexy and instant death. Every experiment of this kind injures the energy of the brain in particular; for, next morning, the poor man is quite deranged and unstrung. In proportion as any machine is abused, its duration will be shortened; so it is with the

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human body: wherefore, if we desire the continuance of health and long life, *excess* of every kind must be religiously avoided.

That the sea diet, or the provisions used at sea, on board his Majesty's ships, are such as will not produce scurvy, provided the seamen be supplied with any *fermenting* drink or liquor abounding with *vegetable* fixed air, as beer, wine, cyder, &c. I am firmly persuaded from a variety of experiments; but, if seamen upon such diet be deprived of such drink, the scurvy will certainly be the consequence.

It

It hath been observed by many judicious men, besides Dr. Lind, that the scurvy always increased in violence, when the ship's small beer having been expended, brandy or rum was served in lieu. Inflammable liquors, ardent spirit, vegetable juice highly charged with phlogiston, and containing no vegetable fixed air, constantly aggravate all the symptoms which occur in the scurvy. But, if some brandy or rum be added to brisk beer, or fermented liquor, strongly impregnated with vegetable fixed air, it will be found to be a very healthy drink for sailors living upon the sea provisions. The reason, as

I have already hinted, why grog is so pernicious in the scurvy, is, because in the tendency to universal decomposition, throughout the system, the brain excepted, a vast quantity of constituent or fixed phlogiston is set loose, becoming excrementitious, which process ardent spirit is found to increase in a rapid manner in this disease, if vegetable fixed air be wanting: though this be not a philosophical reason, yet it is as good, because it is a fact. In the scurvy, phlogiston is copiously discharged from the lungs in respiration, and by stool. The breath and the stools, in this disease, are insufferably foetid.

fœtid. Animal-phlogiston combined with animal putrid air, is, of all others, the most offensive. If ardent spirit be used in this disease, without vegetable fixed air, the oppressed respiration and all the dreadful symptoms will be rendered more violent and fatal.

Seamen labouring under the scurvy, and living upon the sea diet, have their minds greatly bent upon vegetables and fruit; they long exceedingly for beer, cyder, and wine. I have already observed, that relief in this disease may be effectually and abundantly procured without vegetables and fruit; and,

that the same principles which vegetables and fruit yield are copiously contained in brisk fermented liquors.

In countries where the scurvy formerly made great havock, the diet, the manner of living, did not yield such principles as were essential to the well being of the human body ; for, it is observed, now that they drink good malt liquor, and wines, there is no such thing hardly as the scurvy to be found amongst them.

In respect to wine, I have found from considerable experience, that with sea provisions it will prevent the scurvy in a
great

great measure, though not so powerfully and certainly as liquors more strongly impregnated with fixed air, and containing less phlogiston or ardent spirit. I have also found, that wine with the sea provisions will not cure the scurvy. In the advanced stage of the scurvy wine answered merely as a cordial; the disease would not yield to it. But I have found from certain experience, that brisk fermented liquors never failed to cure this dreadful and melancholy disorder, if administered while the organs were yet in a state to be restored by an accession of constituent principles, so as to enable them to

do their functions perfectly in a short time.

I have hinted, that the sea scurvy, the *proper* scurvy, is a tendency in the animal body to decomposition or dissolution.

The principle of cohesion seems to be vanishing, and the constituent principles of the animal fibre would appear to be disposed to repel each other and escape.

That my reader, who may not have studied in medicine, may form some just idea of this disease; and that he may be enabled to distinguish the real
scurvy

scurvy from a variety of complaints which vulgarly pass for scorbutic, I shall beg leave to enumerate some of the principal symptoms of this disorder.

An uncommon lassitude or sensation of universal weariness, with aversion to exercise the most gentle. There is a dejection, a despondency and heaviness throughout. The countenance is wonderfully changed. It looks pale, wan, yellowish, greenish, bloated, relaxed, and cadaverous, bespeaking some sad state of the constitution. There is a feebleness and stiffness of the knees upon any attempt to walk: rigidity, hardness, and
pain

pain in the muscles, of the lower extremities especially, as if having proceeded from labour and much fatigue. There is a breathlessness and universal debility and faintness upon using only a gentle motion of the body; which symptoms are always increased by walking up any ascent. The gums swell, becoming soft, spongy and fungous; they are painful, and bleed upon the least rubbing. They sometimes become gangrenous, and separate. The breath, in the advanced state of the disease, is very offensive indeed. The mouth, lips, and teeth in the morning, are frequently furred, and lined with

with a bloody, offensive slime. The skin of the legs, thighs, &c. looks sometimes like that of a goose newly plucked; at other times there are various coloured eruptions and pimples, bluish, reddish, yellowish, greenish, black, and purple. It shall be as frequently smooth, and glistening, often covered in the extremities and trunk, at uncertain distances, with broad spots, black and livid, as if having been occasioned by blows from a stick, without wound. The ancles and legs become œdematous. In the course of the disease this swelling shall increase, and alter its colour, becoming oftentimes
black

black; and the foot and leg of some persons look as if absolutely mortified. There are hard tumours and bumps about the lower extremities; and sometimes upon the arms and upon the trunk of the body, of different colours and sizes. There are various pains by day and by night, distressing and dejecting, especially of the chest, with oppressed laborious respiration. Cartilage seems to be peculiarly affected in this disease; and, in advanced states, the cartilages of the ribs become enlarged, and even separate. There are hæmorrhages in this dreadful disorder. There is often a griping, a purging, and symptomatic

ptomatic dysentery, accompanied by vomiting in the latter stage; if still no vegetable fixed air can be procured to prevent and remove these various distressing evils.

From the dissection of a variety of bodies which died of this distemper, all the organs seemed to have suffered more or less, the brain excepted.

The vessels, viz. arteries, veins, absorbent vessels, &c. seemed not only to have lost their tone and texture, but were, absolutely, in the extreme ramifications decomposed; whence extravasation of their contents,
and

and accumulation thereof under the skin, in cellular membrane, in and about muscles, in the sheaths of tendons, and in cavities, as in the thorax, abdomen, &c.

I am now come to what I would humbly and most earnestly recommend to the attention of the Government of Great Britain, in particular, and to the Public, universally.

In all countries where commerce prevails, it is acknowledged, that the marine, or true scurvy, is a disease which arises from the want of fresh vegetables, fruit, and fresh meat.

It

It is now established as an incontrovertible fact, that fresh vegetables and ripe fruits are of use in preventing and curing the scurvy, *merely* in consequence of the fixed air and some vegetable phlogiston, which they impart and communicate to the animal body in the course of digestion.

It is a fact, equally incontrovertible, that liquors in a state of vinous or spirituous fermentation, or liquors impregnated in a high degree with fixed air and some phlogiston, in consequence of the decomposition of saccharine matter in, and absorption of its principles

ciples by water, are as certainly (if not more) efficacious in the prevention and cure of the scurvy, as fresh vegetables and ripe fruits.

What I have to recommend is simple, cheap, and universally expedient.

During the course of a long voyage, whenever the ship's small beer or wine shall be expended, let the common fresh water in casks in the hold be converted into beer, in the following manner: let sugar, or treacle, or melasses, in the proportion of, at least two pounds of sugar, or three or four pounds

pounds of melasses, or of treacle, be put to, or dissolved in, every gallon of water which the cask shall contain ; space being always allowed in the cask for the room which the saccharine matter shall possess. Let so much yeast or fresh grounds of fresh beer be added as will cause the mixture to ferment, or work, in the course of a day or so. Let the fermentation go on some days, either with the bung out of the cask, or the bung in, and the vent-peg out. At the expiration of eight or ten days, let the cask be completely stopped, so that no air may escape. If the mixture shall be suffered

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to ferment with the bung out of the cask, some water just warm, should be occasionally added, so as to favour the produced yeast, and gross matter thrown up in the course of the process, to escape or run over.

In this manner, the water in any number of casks may be converted into beer. Stinking water, by this process, will be purified and impregnated in the highest degree with vegetable fixed air. To prevent and cure the scurvy, it will be found, at least, as efficacious as, if not superior to, any small beer in his Majesty's brewhouses. If
a small

a small quantity of hops be added to each cask intended to be kept some time, just before it be bunged up, the taste of the fermented liquor may be thereby rendered more agreeable and familiar to many palates.

To correct stinking water, no method, at sea, can be so expedient and effectual. To render stinking water a medicine, at sea, will, no doubt, be esteemed an object of public concern, in a commercial nation. By treating one or two casks of water in this manner every day, according to the demand, a ship's company may be supplied with

a pleasant, brisk, fermenting beverage.

If the *genuine* essence of malt were adopted, instead of sugar, or treacle, or melasses, an excellent and pleasant beer might be made on board every ship, in the course of a long voyage: but, though it might be judged more palatable than the liquor I have recommended, assuredly, it would not have more efficacy in the prevention and cure of the scurvy: for, the virtue of the liquor depending upon the degree of its impregnation with fixed air, the latter would be found

found as highly charged with it as the former.

Wine is very generally allowed to be one of the best, most generous, and most brilliant of all cordials. Wine is (I shall not be strictly chemical) water charged with ardent spirit and some fixed air. By distillation it is found that good and rich wine yields about one fourth part of its quantity of that ardent spirit called *brandy*.

The people having lived some time upon sea provisions, and there being neither beer nor wine in the ship, and the water

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become offensive and noxious; whenever, in long voyages any occasion shall render it proper to treat the brave fellows with some good and *heartly* stuff, the commander may order the following liquor as a very excellent substitute for the best wine, to be served to them at the rate of one pint each man, more or less, at the discretion of the commander.

Let sixty pounds of soft sugar decompose or ferment in sixty gallons of water, during ten or twelve days; then stop the cask, if it be meant for present use, but if it shall not be intended

tended for immediate use, let the vent-peg be kept out for a time.

To every twelve gallons of this liquor let there be added four gallons of brandy or rum, when the mixture should be immediately served out; otherwise the pungent acidulous principle, the fixed air, would escape, and the liquor would become vapid and flat.

All vegetable matter which decomposes in water by the spirituous fermentation, copiously abounds in these principles, which will not fail to cure
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the scurvy. All the saccharine juices are subjects of the vinous fermentation ; and in general, all vegetable farinaceous substances abound in fixed air and phlogiston, which they yield in water by the above process.

The juice of the grape is abundant in saccharine matter ; whence it is very susceptible of the spirituous fermentation. Two of the essential principles of saccharine matter are fixed air and phlogiston. The juice of the sugar cane is, in a very high degree, charged with saccharine matter. The juice of the sugar cane will make a
strong

strong and most excellent wine; inasmuch as the juice of the sugar cane contains a vast greater abundance of saccharine matter than the juice of the grape.

If I had an estate in the West-Indies producing sugar cane, instead of reducing the whole of the juice of my canes into sugar, I should convert a certain quantity of the juice into wine, by the vinous fermentation.

If this process were properly conducted, it would be found that wine made solely from the juice of the sugar cane, would

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be uncommonly rich, high-flavoured, generous, sparkling, and brilliant.

F I N I S.



ERRATA.

Page 67, line 1, for "*two spoonfuls*" read "*two tea spoonfuls.*" Page 149, line 16, for "*except oil and turpentine*" read "*except in respect of phlogiston, oil, and turpentine.*"

